Amendments to the SPECIFICATION

Please replace paragraph **[0001]** with the following paragraph:

[0001] This application is a divisional of Application No. 10/609,503 filed on July 1, 2003 (now allowed), which is a divisional of Application No. 09/458,024 filed December 10, 1999 (now U.S. Patent No. 6,614,179 issued September 2, 2003), which is a divisional of Application No. 09/300,315 filed on April 28, 1999 (now U.S. Patent No. 6,069,440 issued May 30, 2000), which is a divisional of Application No. 08/902,725 filed on July 29, 1997 (now U.S. Patent No. 5,998,925 issued December 7, 1999). The entire contents of these applications are hereby incorporated by reference.

Please replace paragraph **[00100]** with the following paragraph:

[00100] In the first embodiment, because the phosphor is used by blending with a resin which makes the coating resin 101 and the coating material 201 (detailed later), color tone of the light emitting diode can be adjusted including white and incandescent lamp color by controlling the mixing proportion with the resin or the quantity used in filling the cup 105a or the recess of the casing 204 in accordance to the wavelength of light emitted by the gallium nitride light emitting component.

Please replace paragraph **[00133]** with the following paragraph:

[00133] As for the fluorescent material, a fluorescent material represented by general formula ~~Re1-rSmr)3(Al1-sGas)5O12:Ce~~ $(Re_{1-r}Sm_r)_3(Al_{1-s}Ga_s)_5O_{12}:Ce$ may also be used as the phosphor. Here $0 \le r < 1$ and $0 \le s \le 1$, and Re is at least one selected from Y, Gd and La. This configuration makes it possible to minimize the denaturing of the fluorescent material even when the fluorescent material is exposed to high-intensity high-energy visible light emitted by the light emitting component for a long period of time or when used under various environmental conditions, and therefore a light emitting diode which is subject to extremely insignificant color shift and emission luminance decrease and has the desired emission component of high luminance can be made.

Please replace paragraph **[00148]** with the following:

[00148] Now referring to Fig. 8 and Fig. 9, a planar light source according to another embodiment of the present invention will be described below. The light emitting device shown in Fig. 8 is made in such a configuration that blue light emitted by the light emitting diode 702 is converted to white light by a color converter ~~701~~ 710 which contains phosphor and is output in planar state via an optical guide plate 704.

Please replace paragraph **[00155]** with the following:

[00155] The light emitting diode of the present invention can be used to constitute an LED display device wherein one pixel 400 is constituted of three RGB light emitting diodes 401, 402, 404, and one light emitting diode 403 of the present invention, as shown in Fig. 12. By connecting the LED display device and a specified drive circuit, a display device capable of displaying various images can be constituted. The drive circuit of this display device has, similarly to a case of monochrome display device, video data storage means (RAM)for temporarily storing the input display data, a tone control circuit which processes the data stored in the RAM to compute tone signals for lighting the light emitting diodes with specified brightness and a driver which is switched by the output signal of the tone control circuit to cause the light emitting diodes to illuminate. The drive circuit is required exclusively for each of the RGB light emitting diodes and the white light emitting diode. The tone control circuit computes the duration of lighting the light emitting diodes from the data stored in the RAM, and outputs pulse signals for turning on and off the light emitting diodes. When displaying with white light, width of the pulse signals for lighting the RGB light emitting diodes is made shorter, or peak value of the pulse signal is made lower or no pulse signal is output at all. On the other hand, a pulse signal is given to the white light emitting diode in compensation thereof. This causes the LED display device to display with white light.

Please replace paragraph **[00167]** with the following:

[00167] Formation of a light emitting diode and life tests thereof were conducted in the same manner as in Example 1 except for changing the phosphor from ~~(Y0.8Gd0.2)3Al5O12:Ce~~ $(Y_{0.8}Gd_{0.2})_3Al_5O_{12}:Ce$ to (ZnCd)S:Cu, Al. The light emitting diode which had been formed showed, immediately after energization, emission of white light but with low luminance. In a life test, the output diminished to zero in about 100 hours. Analysis of the cause of deterioration showed that the fluorescent material was blackened.

Please replace paragraph **[00168]** with the following:

[00168] This trouble is supposed to have been caused as the light emitted by the light emitting component and moisture which had caught on the fluorescent material or entered from the outside brought about photolysis to make colloidal zinc to precipitate on the surface of the fluorescent material, resulting in blackened surface. Results of life tests under conditions of energization with a current of 20mA at 25 °C and 20mA at 60 °C with 90% RH are shown in Figs.

13A and 13B together with the results of Example 1. Luminance is given in terms of relative value with respect to the initial value as the reference. A solid line indicates Example 1 and a wavy line indicates Comparative Example 1 in Figs. 13A and 13B.

Please replace paragraph **[00169]** with the following:

[00169] In Example 2, a light emitting component was made in the same manner as in Example 1 except for increasing the content of in the nitride compound semiconductor of the light emitting component to have the emission peak at 460 nm and increasing the content of Gd in phosphor than that of Example 1 to have a composition of ~~(Y0.6Gd0.4)3Al5O12:Ce~~ $(Y_{0.6}Gd_{0.4})_3Al_5O_{12}:Ce$.

Please replace the paragraph [00172] with the following:

[00172] 100 light emitting diodes were made in the same manner as in Example 1 except for adding Sm in addition to rare earth elements Y, Gd and Ce in the phosphor to make a fluorescent material with composition of ~~(Y0.39Gd0.57Ce0.03Sm0.01)3Al5O12~~ $(Y_{0.39}Gd_{0.57}Ce_{0.03}Sm_{0.01})_3Al_5O_{12}$. When the light emitting diodes were made illuminate at a high temperature of 130 °C, average temperature characteristic about 8% better than that of Example 1 was obtained.

Please replace paragraph **[00175]** with the following:

[00175] The light emitting diode of Example 5 was made in the same manner as in Example 1 except for using phosphor represented by general formula ~~(Y0.2Gd0.8)3Al5O12:Ce~~ $(Y_{0.2}Gd_{0.8})_3Al_5O_{12}:Ce$. 100 pieces of the light emitting diodes of Example 5 were made and measured for various characteristics.

Please replace paragraph **[00179]** with the following:

[00179] The light emitting diode of Example 7 was made in the same manner as in Example 1 except for using phosphor represented by general formula ~~Y3(Al0.5Ga0.5)5O12:Ce~~ $Y_3(Al_{0.5}Ga_{0.5})_5O_{12}:Ce$. 100 pieces of the light emitting diodes of Example 7 were made and measured for various characteristics.

Please replace paragraph **[00181]** with the following:

[00181] The light emitting diode of Example 8 was made in the same manner as in Example 1 except for using phosphor represented by general formula ~~Gd3(Al0.5Ga0.5)5O12:Ce~~ $Cd_3(Al_{0.5}Ga_{0.5})_5O_{12}:Ce$ which does not contain Y. 100 pieces of the light emitting diodes of Example 8 were made and measured for various characteristics.

Please replace paragraph **[00184]** with the following:

[00184] ~~In0.05Ga0.95N~~ $In_{0.05}Ga_{0.95}N$ semiconductor having emission peak at 450nm is used as a light emitting component. Light emitting components are made by flowing TMG (trimethyl gallium) gas, TMI (trimethyl indium) gas, nitrogen gas and dopant gas together with a carrier gas on a cleaned sapphire substrate and forming a gallium nitride compound semiconductor layer in MOCVD process. A gallium nitride semiconductor layer having N type conductivity and a gallium nitride semiconductor layer having P type conductivity are formed by switching SiH4 and Cp2Mg as dopant gas, thereby forming a PN junction. For the semiconductor light emitting component, a contact layer which is gallium nitride semiconductor having N type conductivity, a clad layer which is gallium nitride aluminum semiconductor having N type conductivity, a clad layer which is gallium nitride aluminum semiconductor having P type conductivity and a contact layer which is gallium nitride semiconductor having P type conductivity are formed. An activation layer of Zn-doped InGaN which makes a double-hetero junction is formed between the clad layer having N type conductivity and the clad layer having P type conductivity. A buffer layer is provided on the sapphire substrate by forming gallium nitride semiconductor layer at a low temperature. The P type nitride semiconductor layer is annealed at a temperature of 400°C or above after forming the film.

Please replace paragraph **[00189]** with the following:

[00189] 120 parts by weight of the first fluorescent material having a composition of ~~Y3(Al0.6Ga0.4)5O12:Ce~~ $Y_3(Al_{0.6}Ga_{0.4})_5O_{12}:Ce$ and capable of emitting green light prepared as described above and 100 parts by weight of the second fluorescent material having a composition of ~~(Y0.4Gd0.6)3Al5O12:Ce~~ $(Y_{0.4}Gd_{0.6})_3Al_5O_{12}:Ce$ and capable of emitting red light prepared in a process similar to that for the first fluorescent material, are sufficiently mixed with 100 parts by weight of epoxy resin, to form a slurry. The slurry is applied uniformly onto an acrylic layer having a thickness of 0.5 mm by means of a multi-coater, and dried to form a fluorescent material layer to be used as a color converting material having a thickness of about 30μm. The fluorescent material layer is cut into the same size as that of the principal light emitting plane of the optical guide plate, and arranged on the optical guide plate thereby to form the planar light emitting device. Measurements of chromaticity point and color rendering index of the light emitting device gave values of (0.29, 0.34) for chromaticity point (x, y) and 92.0 for color rendering index (Ra) which are approximate to the properties of 3-waveform fluorescent lamp. Light emitting efficiency of 12 lm/W comparable to that of an incandescent lamp was obtained. Further in weatherability tests under conditions of energization with a current of 60mA at room temperature, 20mA at room temperature and 20mA at 60°C with 90% RH, no change due to the fluorescent material was observed.

Please replace paragraph **[00190]** with the following:

[00190] Forming of light emitting diode and weatherability tests thereof were conducted in the same manner as in Example 9 except for mixing the same quantities of a green organic fluorescent pigment (FA-001 of Synleuch Chemisch) and a red organic fluorescent pigment (FA-005 of Synleuch Chemisch) which are perylene-derivatives, instead of the first fluorescent material represented by general formula ~~Y3(Al0.6Ga0.4)5O12:Ce~~ $Y_3(Al_{0.6}Ga_{0.4})_5O_{12}$:Ce capable of emitting green light and the second fluorescent material represented by general formula ~~(Y0.4Gd0.6)3Al5O12:Ce~~ $(Y_{0.4}Gd_{0.6})_3Al_5O_{12}$:Ce capable of emitting red light of Example 9. Chromaticity coordinates of the light emitting diode of Comparative Example 1 thus formed were (x, y) = (0.34, 0.35). Weatherability test was conducted by irradiating with ultraviolet ray generated by carbon arc for 200 hours, representing equivalent irradiation of sun light over a period of one year, while measuring the luminance retaining ratio and color tone at various times during the test period. In a reliability test, the light emitting component was energized to emit light at a constant temperature of 70°C while measuring the luminance and color tone at different times. The results are shown in Fig. 14 and Fig. 15, together with Example 9. As will be clear from Fig. 14 and Fig. 15, the light emitting component of Example 9 experiences less deterioration than Comparative Example 2.

Please replace paragraph **[00192]** with the following:

[00192] In the light emitting diode of Example 10, the light emitting component having a light emitting layer of ~~In0.05Ga0.95N~~ $\underline{In_{0.05}Ga_{0.95}N}$ with emission peak at 450nm which is made in the same manner as in Example 9 is used. The light emitting component is mounted in the cup provided at the tip of a silver-plated copper mount lead, by die bonding with epoxy resin. Electrodes of the light emitting component, the mount lead and the inner lead were electrically connected by wire boding with gold wires.

Please replace paragraph **[00193]** with the following:

[00193] Phosphor is made by mixing a first fluorescent material represented by general formula ~~Y3(Al 0.5Ga0.5)5O12:Ce~~ $\underline{Y_3(Al_{0.5}Ga_{0.5})_5O_{12}:Ce}$ capable of emitting green light and a second fluorescent material represented by general formula ~~(Y0.2Gd 0.8)3Al5O12:Ce~~ $\underline{(Y_{0.2}Gd_{0.8})_3Al_5O_{12}:Ce}$ capable of emitting red light prepared as follows. Namely, rare earth elements of Y, Gd and Ce are solved in acid in stoichiometrical proportions, and coprecipitating the solution with oxalic acid. Oxide of the coprecipitation obtained by firing it is mixed with aluminum oxide and gallium oxide, thereby to obtain respective mixture materials. The mixture is mixed with ammonium fluoride used as a flux, and fired in a crucible at a temperature of 1400°C in air for 3 hours. Then, the fired material is ground by a ball mill in water, washed, separated, dried and sieved thereby to obtained the first and second fluorescent materials of the specified particle size distribution.

Please replace paragraph **[00196]** will the following:

[00196] ~~In0.4Ga0.6N~~ $In_{0.4}Ga_{0.6}N$ semiconductor having an emission peak at 470nm is used as an LED element. Light emitting components are made by flowing TMG (trimethyl gallium) gas, TMI (trimethyl indium) gas, nitrogen gas and dopant gas together with a carrier gas on a cleaned sapphire substrate thereby to form a gallium nitride compound semiconductor layer in the MOCVD process. A gallium nitride semiconductor layer having N type conductivity and a gallium nitride semiconductor layer having P type conductivity were formed by switching SiH4 and Cp2Mg used as the dopant gas, thereby forming a PN junction. For the LED element, a contact layer which is gallium nitride semiconductor having N type conductivity, a clad layer which is gallium nitride aluminum semiconductor having P type conductivity and a contact layer which is gallium nitride semiconductor having P type conductivity are formed. An activation layer of non-doped InGaN with thickness of about 3nm is formed between the contact layer having N type conductivity and the clad layer having P type conductivity, thereby to make single quantum well structure. A buffer layer is provided on the sapphire substrate by forming a gallium nitride semiconductor layer at a low temperature.

Please replace paragraph **[00200]** with the following:

[00200] Phosphor is made by mixing a fluorescent material represented by general formula ~~(Y0.8Gd0.2)3Al5O12:Ce~~ $(Y_{0.8}Gd_{0.2})_3Al_5O_{12}$:Ce capable of emitting yellow light of relatively short wavelength and a fluorescent material represented by general formula ~~(Y0.4Gd0.6)3Al5O12:Ce~~

$(Y_{0.4}Gd_{0.6})_3Al_5O_{12}$:Ce capable of emitting yellow light of relatively long wavelength prepared as follows. Namely, rare earth elements of Y, Gd and Ce are solved in acid in stoichiometrical proportions, and coprecipitating the solution with oxalic acid. Oxide of the coprecipitation obtained by firing it is mixed with aluminum oxide, thereby to obtain respective mixture material. The mixture is mixed with ammonium fluoride used as a flux, and fired in a crucible at a temperature of 1400°C in air for 3 hours. Then the fired material is ground by a ball mill in water, washed, separated, dried and sieved.

Please replace paragraph **[00201]** with the following:

[00201] 100 parts by weight of yellow fluorescent material of relatively short wavelength and 100 parts by weight of yellow fluorescent material of relatively long wavelength which are made as described above are sufficiently mixed with 1000 parts by weight of acrylic resin and extruded, thereby to form a fluorescent material film to be used as color converting material of about 180μm in thickness. The fluorescent material film is cut into the same size as the principal emission plane of the optical guide plate and arranged on the optical guide plate, thereby to make a light emitting device. Measurements of chromaticity point and color rendering index of the light emitting device of Example 3 which is made as described above gave values of (0.33, 0.34) for chromaticity point (x, y), 88.0 for color rendering index (Ra) and light emitting efficiency of 101 m/W. Fig. 22A, Fig. 22B and Fig. 22C show emission spectra of the fluorescent material represented by ~~(Y0.8Gd0.2)3Al5O12:Ce~~ $(Y_{0.8}Gd_{0.2})_3Al_5O_{12}$:Ce and a fluorescent material represented by general formula ~~(Y0.4Gd0.6)3Al5O12:Ce~~ $(Y_{0.4}Gd_{0.6})_3Al_5O_{12}$:Ce used in Example 11. Fig. 23 shows emission spectrum of the light emitting diode of Example 11. Further in life tests under conditions of energization with a current of 60mA at room temperature, 20mA at room temperature and 20mA at 60°C with 90% RH, no change due to the fluorescent material was observed. Similarly, desired chromaticity can be maintained even when the wavelength of the light emitting component is changed by changing the content of the fluorescent material.